NUMS Physics Handmade Notes by Farah

(Chap#6)

Fluid Dynamics

→ study of fluids in motion

* Fluid → any substance that can flow is called as fluid.

Compressible fluids
* $\rho \neq 0$
* (gases + plasma)

Incompressible fluids
* $\rho =$ constant
* (liquids)

Viscosity

→ Frictional effect b/w the layers of a flowing fluid.

→ represented by 'η' → co-efficient of viscosity

→ Nsm^{-2}, Pa s

Effect of temp on viscosity

→ For gases

$\eta_{gases} \propto T \Rightarrow$ Temp ↑, rate of diffusion ↑, η ↑

The viscosity of gases is dependant on rate of diffusion.

For liquids

$\eta_{liquids} \propto \frac{1}{T}$

$T\uparrow$, cohesive forces $\downarrow$, $\eta \downarrow$

Stokes' Law

↳ measurment of drag force

(وہ retarding force جو object پر اثر کرتی
لگتی ہے جب وہ Fluids میں سے گزرتا ہے۔)

→ only for spherical objects

* → $F_D = 6\pi\eta r v$

→ $F_d \propto r$

→ $F_d \propto v$ (low speed)

↳ At high speed not $\propto v$

→ $F_d \propto v^2$ (high speed)

MCQ

* WOF is more viscous ?

(a) air (b) H_2O

(c) glycerine $\boxed{\text{(d)}}$ Honey

* A copper ball of radius 'r' is passing (moving) in a viscous medium with a speed V

having drag force F. Another 'Cu' Ball of radius $r' = 2r$ and $v' = 2v$ will have drag force?

$F_D = 6\pi\eta(2r \times 2v)$

(a) F (b) 2F $= 6\pi\eta\, 4rv$

(c) F/2 (d) 4F $= (6\pi\eta rv)4$

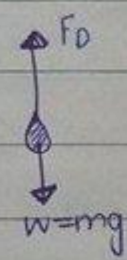
$\boxed{F' = 4F}$

(Imp)

Terminal velocity

- max constant velocity
- $v_t \longrightarrow$ Gain, $a = 0$
- $F_{net} = W - F_d$
- $F_{net} = 0$ $W = F_d$
- $F_d = W \longrightarrow$ terminal vel.
- $\boxed{V_t = \dfrac{mg}{6\pi\eta rv}}$ — (1)

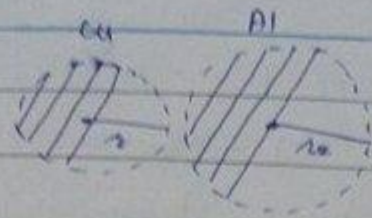
→ For diff. materials having same masses.



(due to inertia ← again move downward ← Body)
when $F_d = W$

* $\boxed{V_t = \dfrac{2\rho g r^2}{9\eta}}$ — (2)

For (1) → condition



$$\boxed{\frac{V_{t_1}}{V_{t_2}} = \frac{r_2}{r_1}}$$ * when m = same

For (2) condition.

(For 2 materials having same density) like H_2O droplets

$V_t \propto r^2$

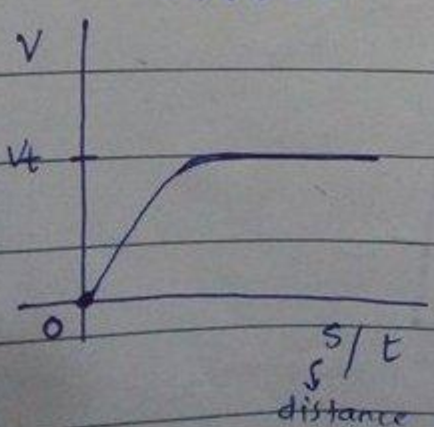
$$\boxed{\frac{V_{t_1}}{V_{t_2}} = \frac{r_1^2}{r_2^2}}$$

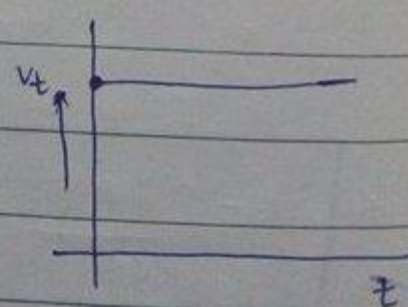
ρ = change in density

$$V_t = \frac{2(\rho_{substance} - \rho_{fluid})\, g r^2}{9\eta}$$

(جب کسی body کو release کیا جاتا ہے کسی medium میں تو اس کو نیچے کی طرف move کرتا ہے تو Vt زیادہ ہو جاتی ہے)

Graphs





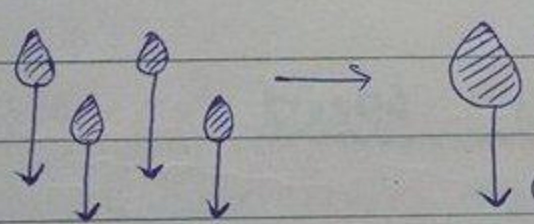
* Two water droplets are falling through air have ratio of radii 2:3. What will be ratio of their Vts?

$$\frac{V_{t1}}{V_{t2}} = \frac{r_1^2}{r_2^2}$$

(a) 9:4 (b) 4:9

(c) 2:3 (d) 3:2

Effect of Combined Terminal velocities



$$\boxed{V_t' = n^{2/3} V_t}$$

$\frac{4\pi}{3} \pi R^3$

$V_t' = (4)^{2/3}(5)$

$V_t = (2^2)^{2/3}(5)$

$V_t = (16)^{1/3}(5)\, cm s^{-1}$

no of droplets $= n = 4$

Vt of each droplet $= V_t = 5 cm s^{-1}$

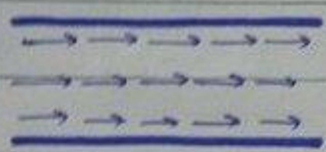
Terminal speed of big droplet $= ?$

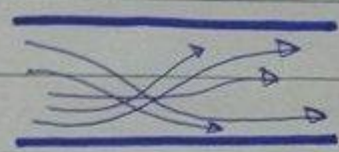
MDCAT Study Buddy (FB Group)

Fluid Flow

Laminar flow
- regular flow
- steady flow

Turbulent flow
- irregular flow
- unsteady flow





Laminar flow:
* layer same
* path same
* only at low speed.
* different stream lines do not cross each other.

Turbulent flow:
* resistance↑
* dissipation↑
* high speed
* stream lines cross each other

Critical Speed

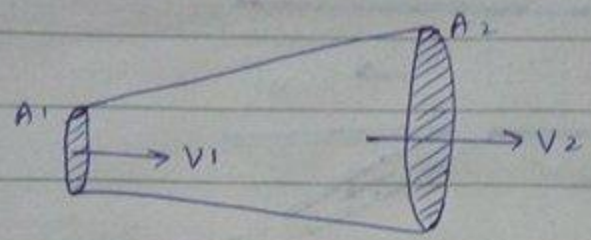
- at which Laminar ⇌ Turbulent

Ideal Fluid

- incompressible $\rho = constant$
- steady flow (laminar)
- non-viscous $(\eta = 0)$

Equation of continuity

→ explains law of conservation of mass



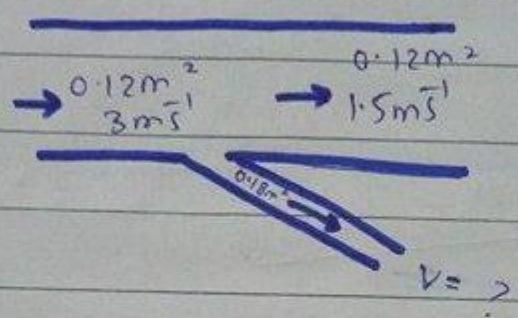
* volume flow rate $= \frac{V}{t} = Av$
* units $= Av = m^3 s^{-1}$
* $A_1 v_1 = A_2 v_2$
* $\boxed{\frac{v_1}{v_2} = \frac{A_2}{A_1}} \Rightarrow \boxed{\frac{v_1}{v_2} = \frac{r_2^2}{r_1^2}} \Rightarrow \boxed{\frac{v_1}{v_2} = \frac{d_2^2}{d_1^2}}$

* water is flowing through ~~of~~ a tube of non-uniform cross-sectional area. if the radii of tube at entrance and exit are in the ratio 3:2 then ratio of velocity of liquid entering and leaving the tube is?

(a) 1 : 1 (b) 4 : 9

(c) 9 : 4 (d) 1 : 27

*



(a) $1ms^{-1}$ (b) $2.25ms^{-1}$

(c) 1.25 (d) $2ms^{-1}$

$$A_1V_1 = A_2V_2 + A_3V$$

$$V = \frac{A_1V_1 - A_2V_2}{A_3}$$

$$V = \frac{0.12m^2 \times 3ms^{-1} - 0.12m^2 \times 1.5ms^{-1}}{0.18m^2}$$

Bernoulli's Equation

↳ explain law of conservation of energy

* $P_1 + \frac{1}{2}\rho V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g h_2$

* $p + \frac{1}{2}\rho v^2 + \rho g h = \text{constant}$

* $\frac{p + \frac{1}{2}mv^2}{V} + \frac{mgh}{V} = \text{constant}$

* xply with V

* $pV + \frac{1}{2}mv^2 + mgh = \text{constant}$

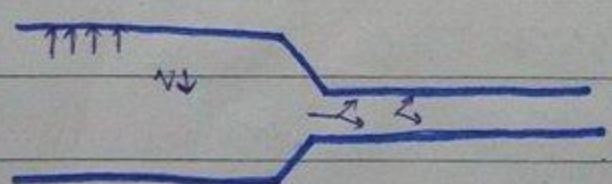
MCQ

* WOF is pressure?

(a) $p \rightarrow$ static (b) $\frac{1}{2}\rho v^2 \rightarrow$ dynamic pressure

(c) $\rho g h \rightarrow$ pressure with depth (d) all.

Same physical quantities are added.



$\uparrow p + \frac{1}{2}\rho v^2 \downarrow = \text{constant}$ $\downarrow p + \frac{1}{2}\rho v^2 \uparrow = \text{constant}$

↑↑↑ ⟶ pressure

↳ Dynamic

enough time to exert pressure.

MDCAT Study Buddy (FB Group)

Past paper question

* water is flowing through a horizontal pipe of non-uniform cross-sectional area $\Delta P.E = 0$ WOF is correct?

(a) $P + \rho v^2 = \text{constant}$

(b) $2P + 2\rho v^2 = \text{constant}$

(c) $2P + \rho v^2 = \text{constant}$

(d) $2p + 2\rho = \text{constant}$

$$P + \frac{1}{2}\rho v^2 = \text{constant}$$

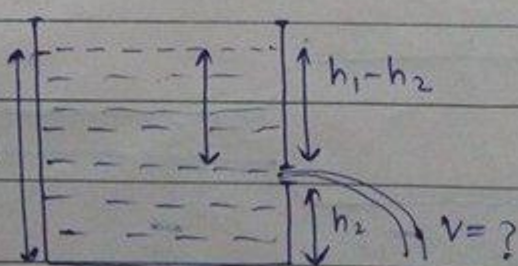
$$2p + \rho v^2 = \text{constant}$$

Applications of Bernoulli's Equation

Torricelli's Theorem:

*depth from surface → reference point

* height earth reference point



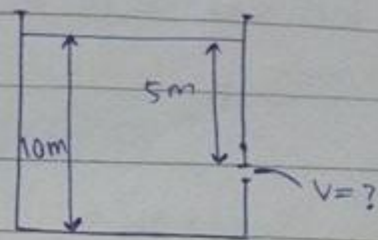
$$v = \sqrt{2g(h_1 - h_2)}$$

$$h_1 - h_2 = h = \text{depth}$$

$v = \sqrt{2gh}$

$v \propto \sqrt{h}$

* $v = ?$



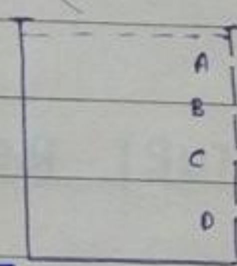
$v = \sqrt{2gh}$

$v = \sqrt{2 \times 10 \times 5}$

$= \sqrt{100} = 10ms^{-1}$

(a) $10ms^{-1}$ (b) $20ms^{-1}$ (c) $30ms^{-1}$ (d) $40ms^{-1}$

*



→ $\boxed{v_D > v_C > v_B > v_A}$

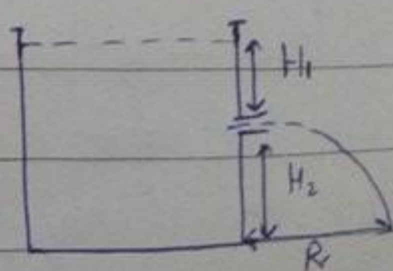
$v \propto \sqrt{h}$

$v\uparrow \propto$ depth$\uparrow$

→ $\boxed{h_D > h_C > h_B > h_A}$

Range of EFFLUX

$Y = \frac{1}{2}gt^2$



$S = vt$

$R = \sqrt{2gH_1} \times \sqrt{\frac{2H_2}{g}}$

$R = \sqrt{\frac{4\cancel{g}H_1H_2}{\cancel{g}}}$

$\boxed{R = 2\sqrt{H_1H_2}}$

* vacuum no medium so the F_D will be zero and $V_t = 0$.
* speed of sound in vacuum is zero.

* $V_t = \frac{mg}{6\pi \eta r}$ r → size same

$V_t \propto mg$

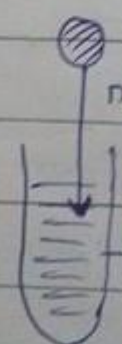
more mass weight↑

← Fe Al

* viscous force on a spherical body moving through a fluid do not depend on mass.

$F_D = 6\pi\eta r v$

* $F_{net} = W - F_d$
$= 10 - 0$
$10 =$



not in the fluid
glycerine

$F_{net} = W - F_d$
$= 10 - 2$
$8 = F_{net}$
$6 = 10 - 4$

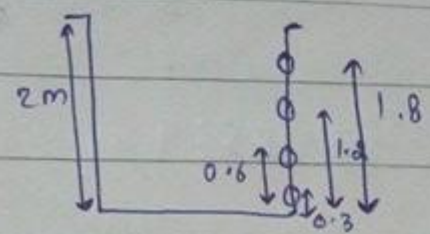
$F_{net}\downarrow$
W = remains same

$F_d \propto \frac{1}{F_{net}}$

4 = 10 − 6
2 = 10 − 8
0 = 10 − 10

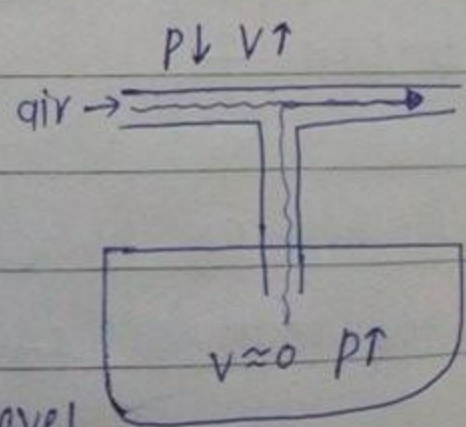
decrease = Fd
Fnet ↓

* $V \propto \frac{1}{height}$



* diastolic pressure, flow of blood is laminar 75–80 torr.

* water stands at level B in the capillary tube in the arrangement shown in figure. if a jet of air is blown into the horizontal tube in the direction. then



↓

* rise above level B in capillary tube.

* $V_t = \frac{mg}{6\pi\eta r}$ $V_t \propto \frac{m}{r}$

$\frac{V_{t_1}}{V_{t_2}} = \frac{m_1}{m_2} \times \frac{r_2}{r_1}$

$= \frac{5}{3} \times \frac{5}{3} = \frac{25}{9} = 25:9$

$V_{t_1} : V_{t_2} = 25:9$

* pressure of fluid is low where stream lines are closer to each other.

*

$\frac{V_1}{V_2} = \frac{r_2^2}{r_1^2}$

$V_2 \propto \frac{1}{r_2}$ $V_2 \propto \frac{1}{(\frac{r}{2})^2}$

$4V_2 \propto \frac{1}{(\frac{r}{2})^2}$

* carburetor of motor car works on Bernoulli's equation.

* let the 90000 kg mass of pure water falls on the pulley of the turbine in 1.5 min to

run the generator. flow rate?

$Av = $ flow rate

$Av = V/t = \frac{\cancel{90}}{\cancel{90}} = 1 m^3 s^{-1}$

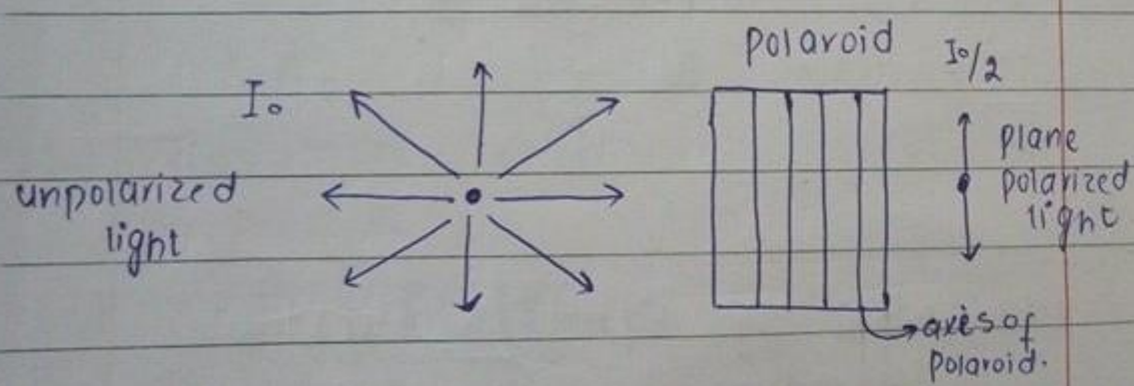
$\rho = m/V$

$= \frac{90,\cancel{000}}{1\cancel{000}} = 90$

$V = m/\rho$

Unit #4 polarization

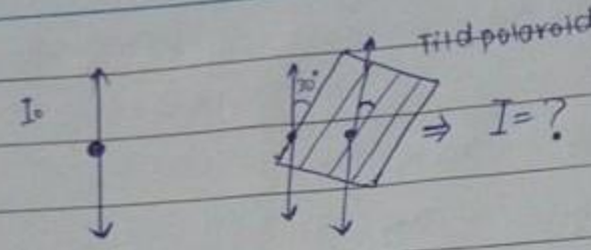
→ confining of light beam in a single plane is called polarization.



Malus Law

$I = I_o \cos^2\theta$

→ aplicable only for plane polarized light



MCQ

* A polaroid is placed in front of a plane plorarized light. Now if we give a polaroid a rotation of 45° what will be the I of emergent ray if max I_0 of ray.

(a) I_0 $\boxed{\text{(b) } I_0/2}$

(c) $\frac{I_0}{\sqrt{2}}$ (d) $\frac{I_0}{4}$

* polarization of light proves that

(a) particle nature of light (b) Quantum nature of light

(c) transverse wave nature of light (d) longitudnal wave nature of light

* Sound waves can never be

polarized.

* Plane polarized light is passed through a polaroid. On viewing through the polaroid we find that when the polaroid is given one complete rotation.

(a) The intensity gradually becomes zero and remains zero
(b) There is no change in intensity of light
(c) Remains maximum
(d) intensity of light varies such that it becomes twice max and twice zero.

LIGHT

Near point/least distance of distinct vision (d = 25cm)

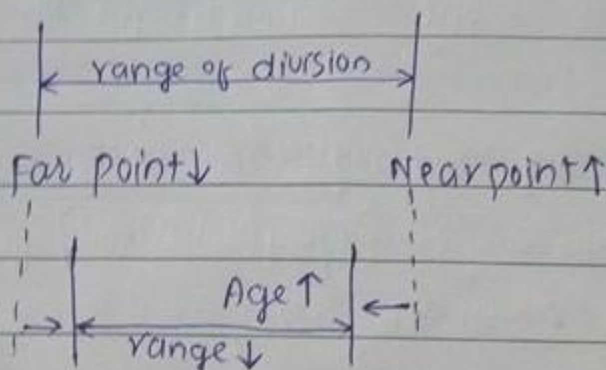
→ normal healthy person d = 25cm
→ newbon baby 5-7 cm
→ with increase in age this (d) also increase.

Far point

↳ infinity ∞ for healthy normal person.

→ age increase it decreases.

Range of vision

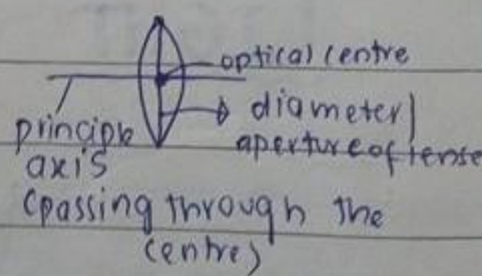


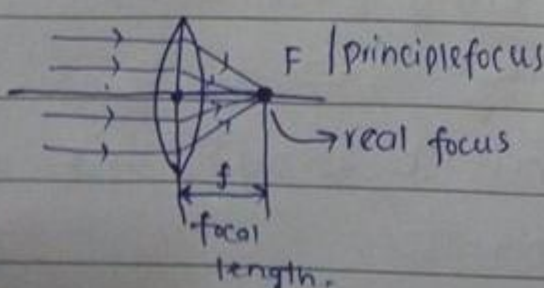
Ray Diagrams

Lenses

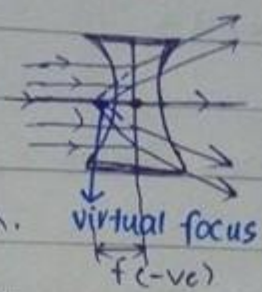
↳ convex lense

↳ converging



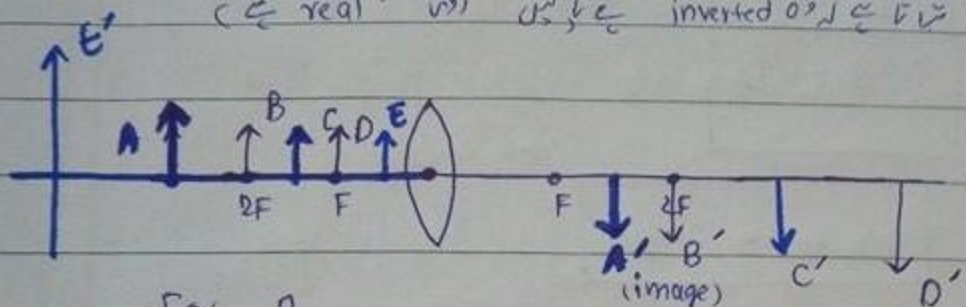


↳ concave lense
↳ diverging lense



→ virtual focus
→ -ve focal length.

(جب image) object سے دوری سائیڈ پر بنے اور arrow
الٹا بنے یعنی inverted ہو، نیچے بنے اور real ہے)



For A

* A′, real, inverted, small size, M<1

$$M = \frac{\text{size of image}}{\text{size of object}}$$

For B

* B′, real, inverted, same size, M=1

For C

* C′, real, inverted, magnified, M>1

For D

* D′, real, inverted, magnified, M>1
↳ telescope.
at ∞.

For E

* E′, virtual, erect, magnified, M>1
↳ simple microscope

simple microscope

$\boxed{M = 1 + \frac{d}{f}}$

d = near point f = focal length of lense

At ∞ (when image is at ∞)

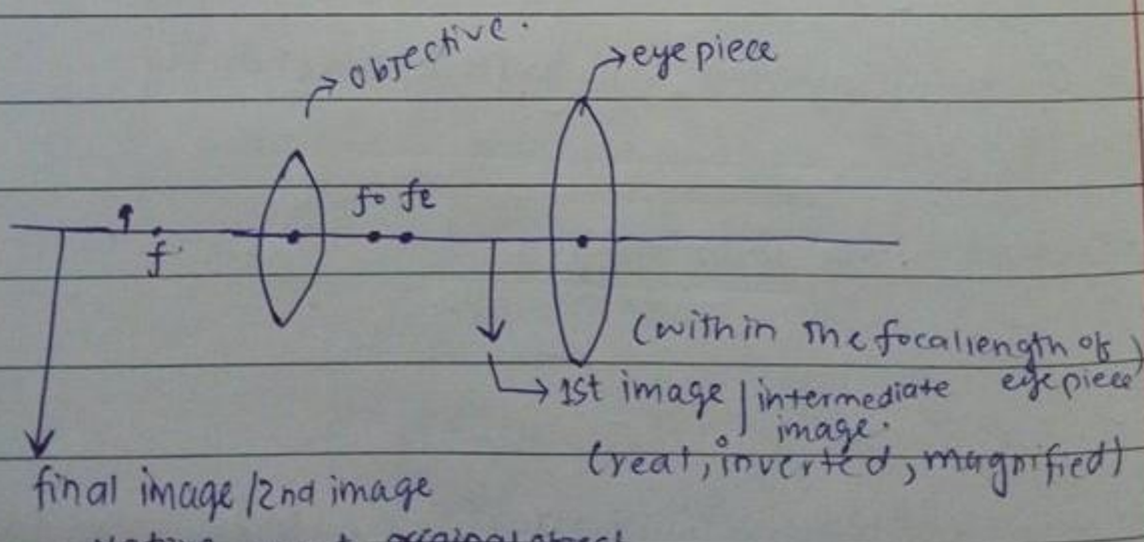
$\boxed{M_\infty = d/f}$

$\boxed{M = 1 + M_\infty}$

Compound Microscope

- consist of 2 lenses (convex)
- eye piece (towards eye)
- objective (towards object)

eyepiece $f_e \uparrow$ objective $f_o \downarrow$



~~Nature w.r.t original object~~

(inverted, virtual, magnified)

Nature with respect to 1st / Intermediate image.

(virtual, erect, magnified)

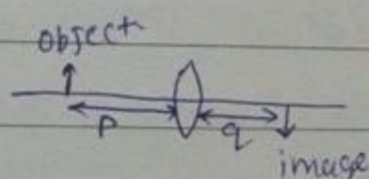
Length of Microscope

The distance b/w two lenses.

$$\boxed{\begin{aligned} &* \ M = \frac{q}{p}\left(1 + d/f_e\right) \\ &* \ M = \frac{L}{f_o}\left(1 + d/f_e\right) \\ &* \ M = M_1 M_2 \end{aligned}}$$

Lens Formula

$$\frac{1}{f_o} = \frac{1}{p} + \frac{1}{q}$$



Test Discussion

$R = D/1.22\lambda$

R → resolving power; D → diameter; λ → wavelength of light.

magnification have no units.

$f_e = 5cm$. $M = M_o \times M_e$

$M_{compound} = 30$

$$M = M_o\left(1 + d/f_e\right)$$

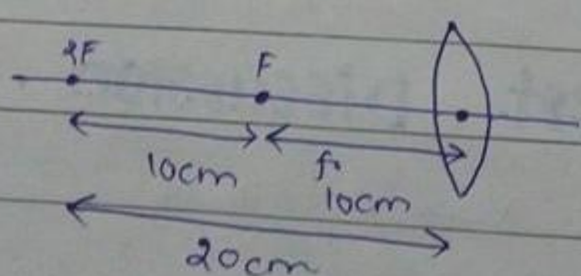
$$M_o = \frac{M_{compound\ microscope}}{1 + d/f_e}$$

$$= \frac{30}{(1 + 25/5)} = \frac{\cancel{30}}{\cancel{6}} = 5$$

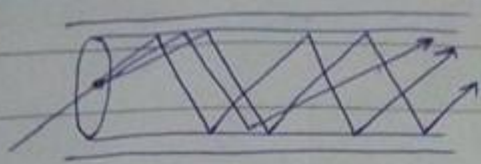
* The normal human eye can focus a sharp image of an obj on the eye, is located at any where b/w ∞ and near point (25cm)

* Magnifying power of compound microscope
  = Objective magni. X eye piece mag.
  $M = M_o \times M_e$

* An object is placed at 20cm from a lens whose focal length is 10cm. The final image will form at 20cm.



* Multimode step index fiber.



→ divide in component colours
⇓
speed different
so the information will reach according to its speed.

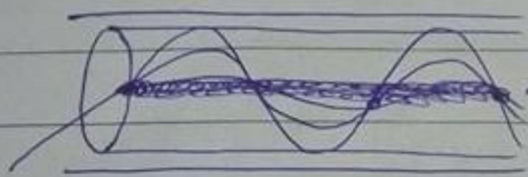
white light

33 ns/km.

principle.

⇒ Total internal reflection.

optical fibre.



signal will meet at a point.

* A 2mm (size) object is placed at 20cm from a coverging lens of 10cm focal length. The size of image is at 2m.

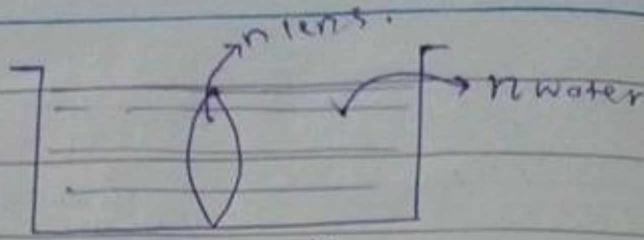
VIB GYOR
↓
visible to eye ↓

* Scattering $\propto \frac{1}{\lambda^4}$

$R \propto \frac{1}{\lambda}$

* most sensitive colour is yellow to eye.

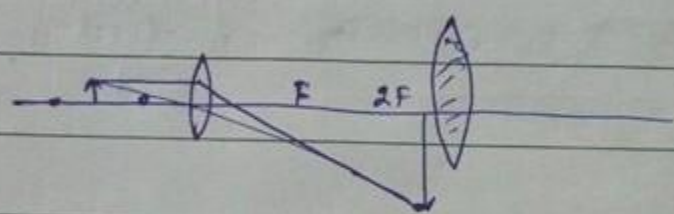
* light bend due the difference in refractive index.



Focal length = ∞

if $n_{H_2O} = n_{lens}$
light will not bend
and combine at ∞.

* when object is placed b/w F and 2F the image is formed.



* λ of X-rays falling at glancing angle of 30° on crystal with grating spacing 2×10^{-09} m for the first order diffraction.

$$2d\sin\theta = n\lambda$$

$$\lambda = \frac{2d\sin\theta}{n}$$

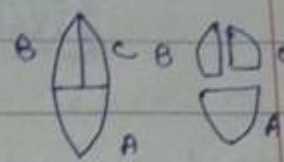
$$= \frac{2(2\times10^{-9})\sin 30^\circ}{1}$$

$$= 2(2\times10^{-9}) \times \frac{1}{2}$$

$$\boxed{\lambda = 0.2\times10^{-10}}$$

no difference of focal length or Thickness

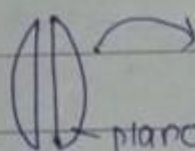
→ differ. in Thickness.



$f \propto \frac{1}{\text{thickness}}$

$\text{power} \propto \frac{1}{\text{focal length}}$

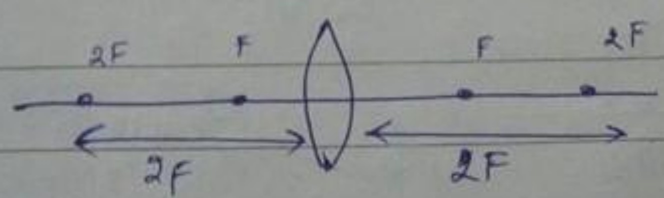
* Biconvex lens / double convex lens.



Bind / merge
↳ Biconvex.

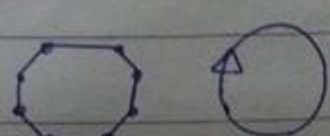
planoconvex lens.

* distance b/w obj and image is never less than 4F ↳ minimum.



* $P = \frac{100}{f(cm)}$, $P = \frac{1}{f(m)}$

↳ power.

* 

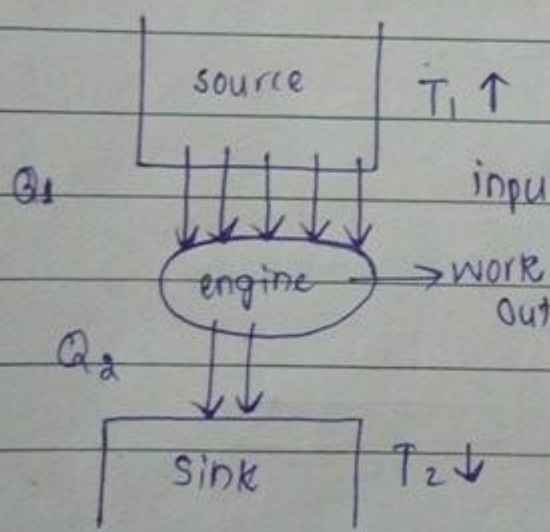
360° 2π rad.
1 rotation.

$\theta = 2\pi/8 \text{ rad.} = 2(180)/8 = 45° = \pi/4$

* $n = c/v$ less than c
↓
in medium.

Heat Engine

- → device
- → heat energy → mechanical energy
- → working ?
  - → source of heat T_1 ↑↑↑
  - → sink (rejected heat) T_2 ↓↓↓
  - → working substance (engine).



input $Q_1 = W + Q_2$

→ work output $W = Q_1 - Q_2$

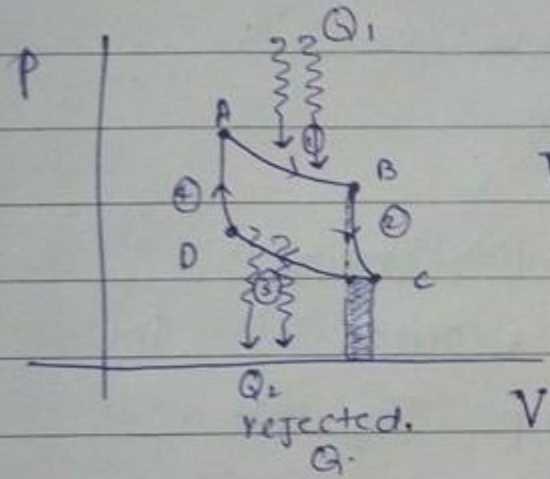
(2nd law of Thermodynamics)
↳ it is impossible to devise an engine that convert all heat into work.)

W = output

Q_1 = input

Carnot Engine / cycle

1. → isothermal expansion
2. → adiabatic expansion
3. → isothermal compression
4. → adiabatic compression.



U = constant
$\Delta U = 0$

isothermal expansion → Q_1 heat absorbed.

isothermal compression → Q_2 rejected.

* efficiency $= \eta = 1 - \frac{T_2}{T_1}$

* $\eta = \frac{\text{output}}{\text{input}}$
$= \frac{W}{Q_1}$

* $\eta = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_2}{Q_1}$

* $\% \eta = \left(1 - \frac{T_2}{T_1}\right)100$

* $\eta = 1 - \frac{T_2}{T_1}$

$$\frac{W}{Q_1} = 1 - \frac{T_2}{T_1}$$

⇨ $T \propto Q$

⇨ $\frac{T_1}{T_2} = \frac{Q_1}{Q_2}$

carnot engine

* efficiency depends on the two temp. of sink and source.

* The efficiency of carnot engine can be 100% at 0 kelvin.
* 0 kelvin is not possible.

MCQs

* A carnot engine is operating b/w 27°C and -123°C. What will be η of this engine.

T(K)
t(°C)

(a) 0.75 (b) 0.4
(c) 0.5 (d) 1

$\eta = 1 - \frac{T_2}{T_1}$

$T_2 = -123 + 273K$
$= 150K$
$T_1 = 300K.$

$\eta = 1 - \frac{150}{300}$

$\eta = \frac{300-150}{300}$

$\begin{array}{r} 273 \\ 123 \\ \hline 150 \end{array}$

* A carnot engine is operating b/w two temp 300K and 600K. If the output work is 800J. Then the absorbed heat by engine is?

$\frac{W}{Q_1} = 1 - \frac{T_2}{T_1}$

$\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$

$\frac{800}{Q_2} = \frac{\cancel{600}}{\cancel{300}}^{2} = 1600J$

$\frac{800}{Q_1} = 1 - \frac{600}{300} = \frac{300-600}{300} = \frac{\cancel{300}}{\cancel{300}}$

1-1

(a) 1200J (b) 1600J
(c) 200J (d) 2400J

$Q_2 = 800 \times 2$
$= 1600J$

* A Carnot engine takes 300 calories of heat at 500K and rejects 150 cal of heat to sink. The temperature of sink will be.

(a) 1000K (b) 750K
(c) 500K (d) 250K.

$$\frac{T_1}{T_2} = \frac{Q_1}{Q_2}$$

$$T = \frac{T_1 Q_2}{Q_1}$$

$$= \frac{500K(300)cal}{150\,cal}$$

$$= 250k$$

* A carnot engine is operating b/w two temp 427°C and 27°C What will be the % η of this engine?

$$\%\eta = \left(1 - \frac{T_2}{T_1}\right)100.$$

$$= \left(1 - \frac{300k}{700k}\right) \times 100.$$

$$= \left(\frac{700 - 300}{700}\right) \times 100$$

$$= \frac{400}{700} \times 100$$

$$\%\eta = 57\%$$

Test Discussion (5+6)

The frequency of light having wavelength 3×10^{-3} cm.

$$f = c/\lambda = \frac{3 \times 10^{8}}{3 \times 10^{-5}} = 10^{8+5} = 1 \times 10^{13} Hz$$

* $\%$age error $= \frac{332 - 280}{332} \times 100 \approx 16\%$

* In all real process where heat, the energy available for doing useful work decreases entropy increases.

* $V = \sqrt{\frac{\gamma P\uparrow}{\rho\uparrow}}$ $\quad P = \frac{1}{3}\rho \langle V^2 \rangle$

$\uparrow P \propto \rho\uparrow$

* جب کسی available heat میں کمی ہو رہی ہے تو entropy
increase ہو جاتی ہے۔

Sand (hot) + Salt (cold) entropy ↑

available heat ↓

Short cut

* $T_f(K) = n^2 \, T_i(K)$

n = no of times

$T_f(K) = (2)^2 \times (283K)$

$= 4 \times 283$

$T_f(K) = 1132K$

* At what temp the velocity of sound in air is two times its velocity at 10°C

Laplace $= E_a = \gamma P$

* $V = \sqrt{\dfrac{\gamma P}{\rho}} = \sqrt{\dfrac{E_a}{\rho}}$

$V \propto \sqrt{E_a}$

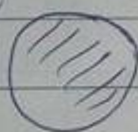
$\dfrac{E_a}{E_i} = \dfrac{\gamma P}{P} = \gamma = C_P / C_V$

E_i ↳ newton

E_i = Isothermal modulus of elasticity $= P$

* density of dry air $= 1.29\,kgm^{-3}$
density of moist air =
By volume the gases are
more N_2 O_2.
$28 + 32 = 60\,amu$.
dry air
Volume = same

$\rightarrow N_2\ O_2$

moist air
$28 + 32 = 60\,amu$
mass

$\rightarrow N_2\ O_2$
replace H_2O
replace
$H_2O + O_2$
$18 + 32 = 50\,amu$.

$\rho = m/V$ dry air
$m\uparrow\ \rho\uparrow$

moist air
Volume = same
$\downarrow \rho = \frac{m\downarrow}{V}$

$V = \sqrt{\frac{\gamma P}{\rho}}$ $\uparrow V \propto \frac{1}{\sqrt{\rho\downarrow}}$

$\frac{\uparrow V_{moist}}{\downarrow V_{dry}} > 1$

* velocity of sound in vacuum is zero and sound wave is a mechanical wave.

* At what temp the speed of sound in air will be 1.5 times its value at 27°C in air?

↳ 402°C

$$T_f(K) = n^2 T_i(K)$$

* light move from denser to rarer the speed (~~increases.~~) decreases.

* sound waves when move from air to water decreases.

$c = f\lambda$ → same in vaccum.

LOGIC GATES

↳ logic circuits

↳ perform logic operations.

OR	AND	NOT
like addition	like multiplication	compliment ↳ inverted like.

how to read gate

$X = A \cdot \bar{B} + \bar{A} \cdot B$

① ② ③ ④ ⑤

NOT operation

↓

' — '

• (AND) + (OR)

$\bar{B} \cdot 0 = 0$

$\bar{A} + 0 = 0/1$

$\bar{\bar{A}} = A$

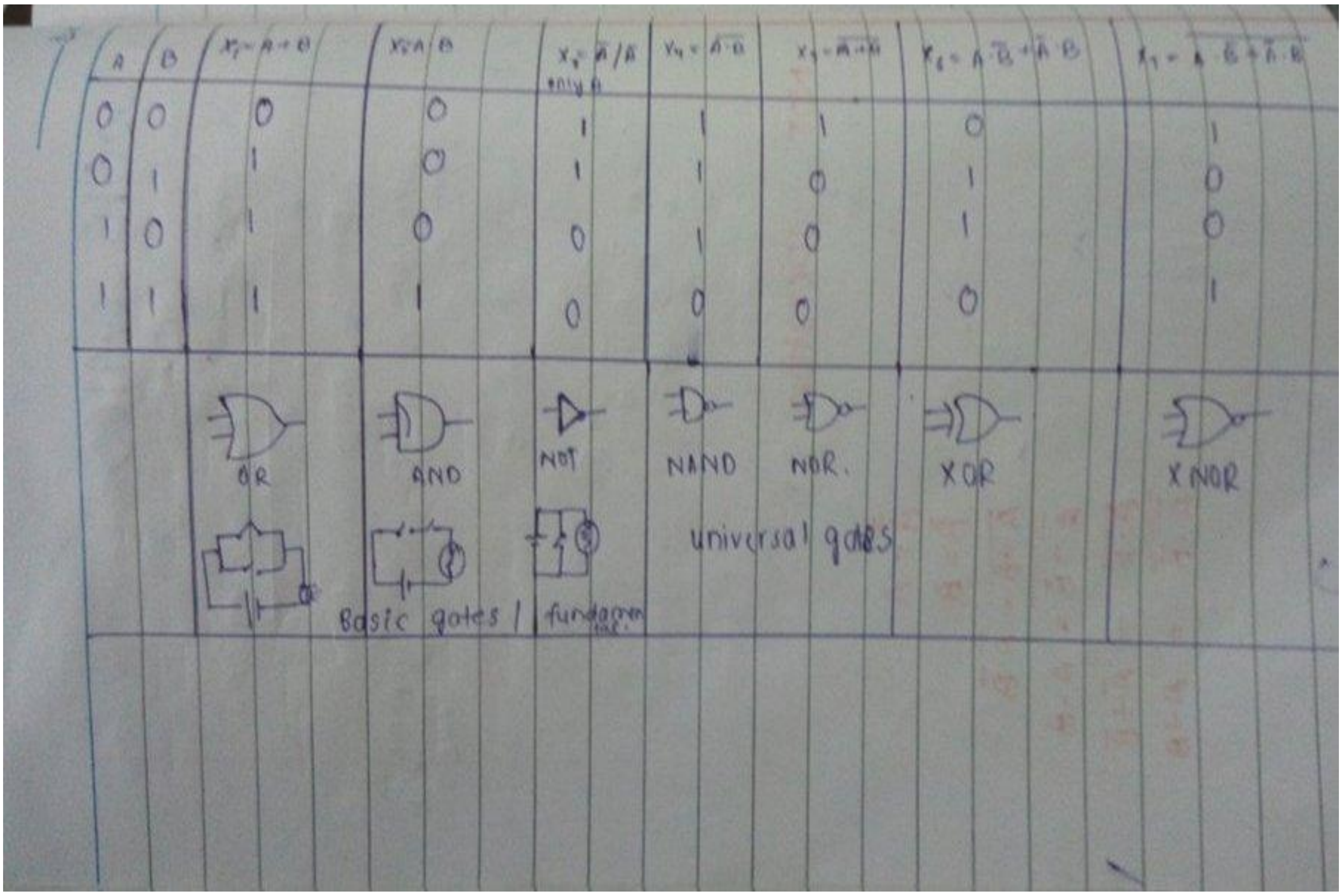
$\bar{\bar{B}} = B$

$\overline{A + B} = \bar{A} \cdot \bar{B}$

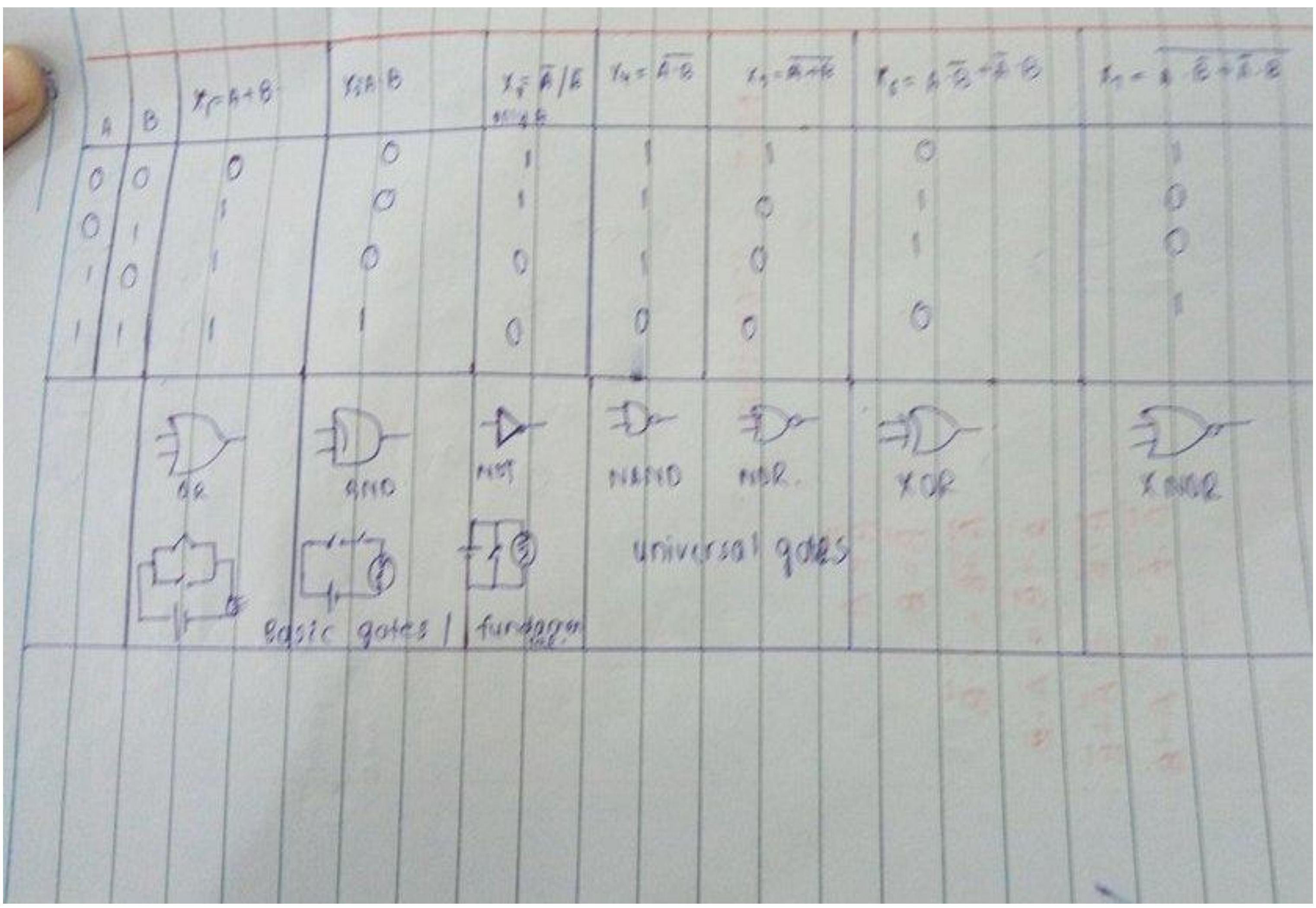
$\overline{\bar{A} + \bar{B}} = A \cdot B$

$\overline{A \cdot B} = \bar{A} + \bar{B}$

$\overline{\bar{A} \cdot \bar{B}} = A + B$



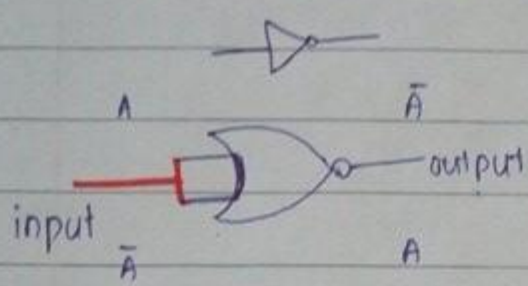
A	B	$X_1 = A+B$	$X_2 = A\cdot B$	$X_3 = \bar{A}/\bar{B}$ only A	$X_4 = \overline{A\cdot B}$	$X_5 = \overline{A+B}$	$X_6 = A\cdot\bar{B} + \bar{A}\cdot B$	$X_7 = \overline{A\cdot\bar{B} + \bar{A}\cdot B}$
0	0	0	0	1	1	1	0	1
0	1	1	0	1	1	0	1	0
1	0	1	0	0	1	0	1	0
1	1	1	1	0	0	0	0	1



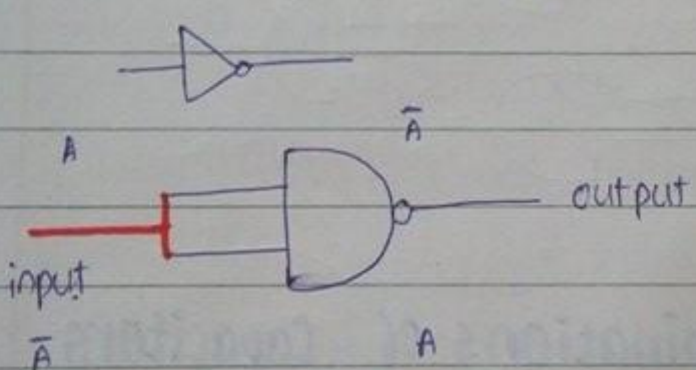
Universal Gates

- → NOR gates
- → NAND gate

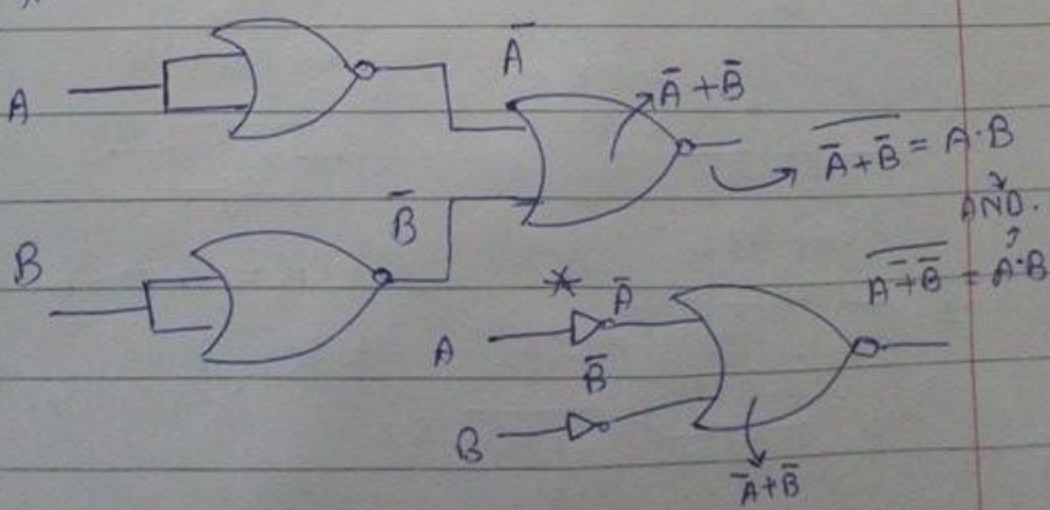
* NOR AS NOT gate

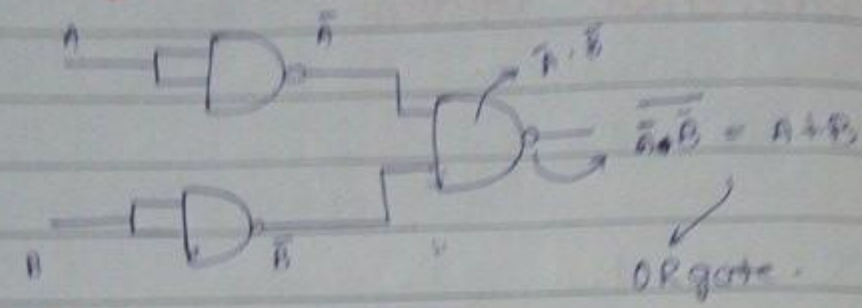


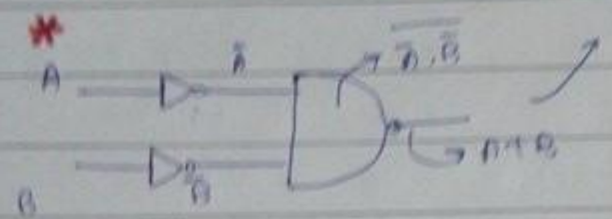
* NAND AS NOT gate

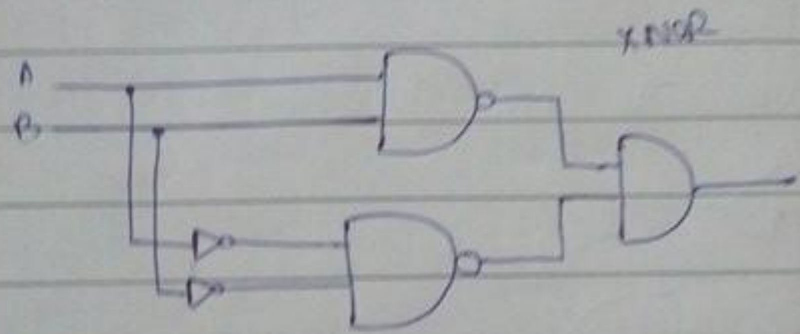


*





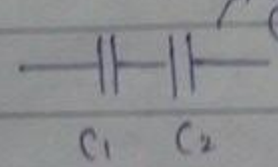


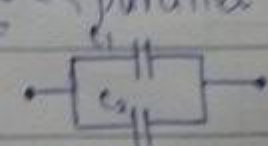


Combinations of Capacitors

Series — V = diff, Q = same

Parallel — V = same, Q = diff





* $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$
* $C_{eq} = \frac{\text{product}}{\text{sum}} = \frac{C_1 C_2}{C_1 + C_2}$.

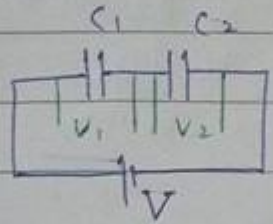
* $C_{eq} = C_1 + C_2$
* For similar capacitors

For similar capacitor $\quad$ * $C_{eq} = nC$

$C_{eq} = \frac{C}{n}$ → no of capacitors.

VOLTAGE DIVISION IN CAPACITOR

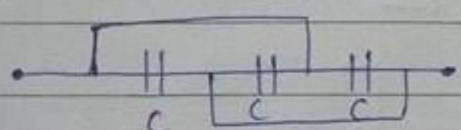
(only for series due to diff. V)



$$V_1 = \frac{C_2}{C_1 + C_2} \times V$$

$$V_2 = \frac{C_1}{C_1 + C_2} \times V$$

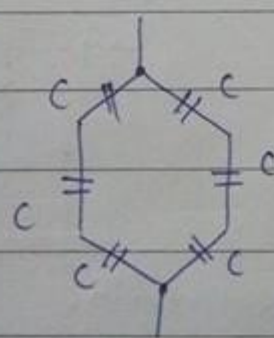
*



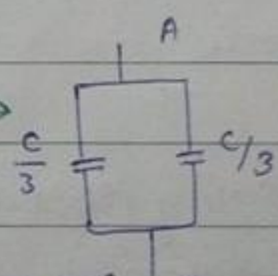
parallel

$C_{eq} = nC \quad = 3C$

*

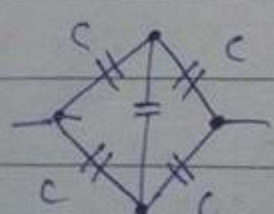


→



$C_{eq} = nC$

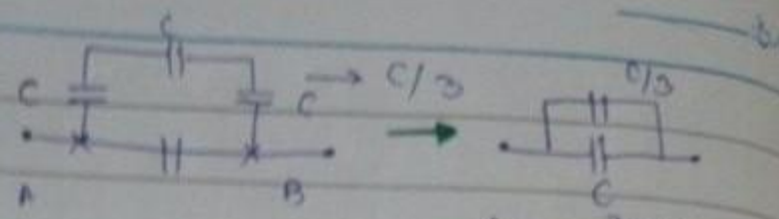
$= 2(C/3) = 2C/3.$



$\boxed{C_{eq} = C}$

* centre neglect ↓ product of side capacitor same so balanced.

↳ same as resistor



$$C_{eq} = \frac{3C + C}{3} = \frac{4C}{3}$$

CRO

- high speed graph plotting device
- work for both A.C / D.C
- uses electronic beam.

Components:

(1) electron gun
- Filament
- cathode
- Grid
- Three anode.

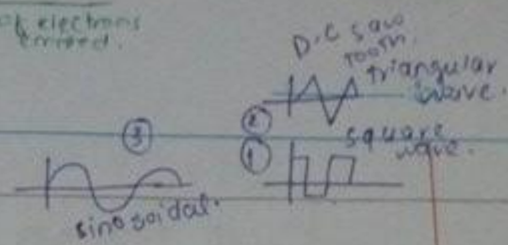
(2) Deflection plates
- X-deflection plates.
- Y-deflection plates.

(3) Display system
- internally coated with.
- ZnS
- ZnO
- zinc orthosilicate

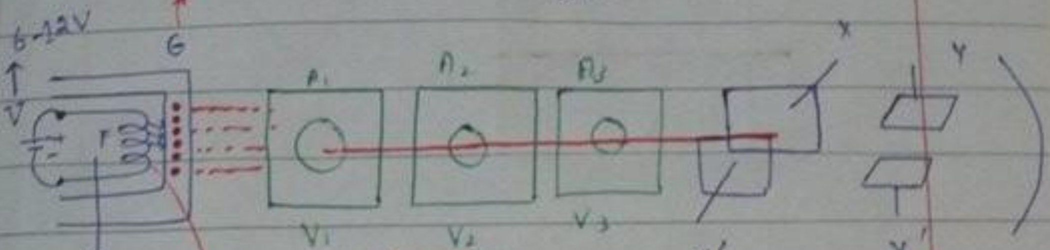
$V_g \propto \frac{1}{\text{Brightness}}$ — Grid potential

$V_g \propto \frac{1}{\text{no. of electrons emitted}}$

more -ve potential → less electrons reach → brightness (spot formed) controlled



6-12V



heating effect $H = I^2Rt$

emission of electrons → Thermionic emission → Thermions

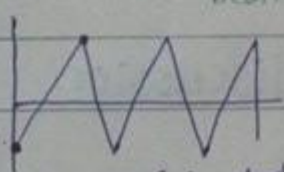
$V_3 > V_2 > V_1$

* +ve w.r.t Grid

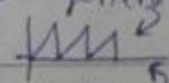
anode — focuses e's beam; accelerates the e's beam.

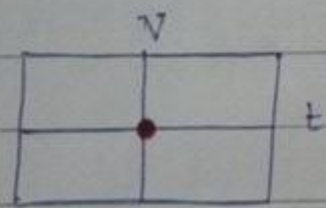
* Vertical plates
* field pattern
* horizontal deflection along horizontal plane
* potential provider → Time base generator → build in CRO → only this

* horizontal plates
* vertical
* deflection along vertical pattern/axis
* any type voltage → sawtooth, square wave, sinosoidal

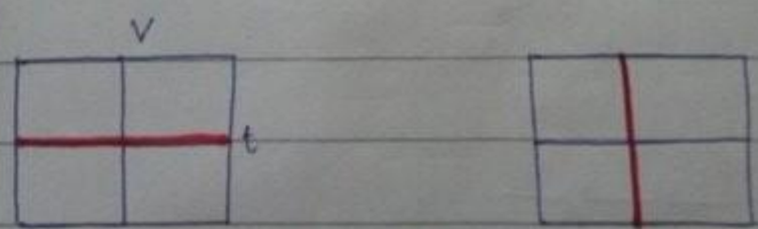


A.C Sawtooth → in real



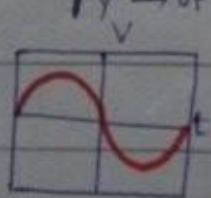


$XX' \rightarrow$ OFF, $YY' \rightarrow$ OFF → no deflection (Bright spot at centre)

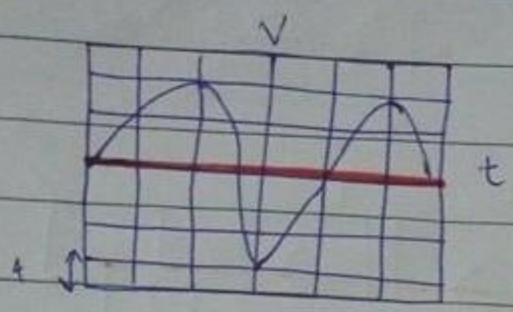


$XX' \rightarrow$ ON, $YY' \rightarrow$ OFF → horizontal straight line

$XX' \rightarrow$ OFF, $YY' \rightarrow$ ON → vertical straight line



$XX' \rightarrow$ ON, $YY' \rightarrow$ ON → Sinosoidal wave on screen.



$f = ?$

$T = ?$

$V_p = ?$

$V_{p \cdot p} = ?$

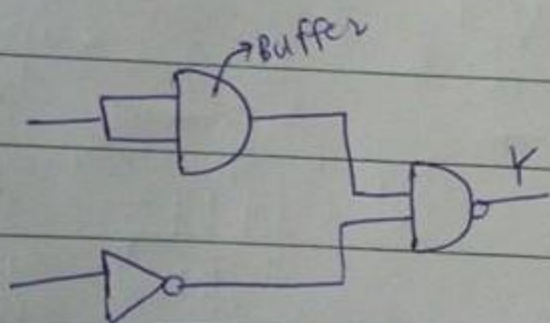
$T = 5ms \times 4 = 20$

$f = \frac{1}{20 \times 10^{-3}} = \frac{1000}{20} = 50 Hz$

$V_p = 4V$

$V_{p-p} = 8V.$

Test discussion



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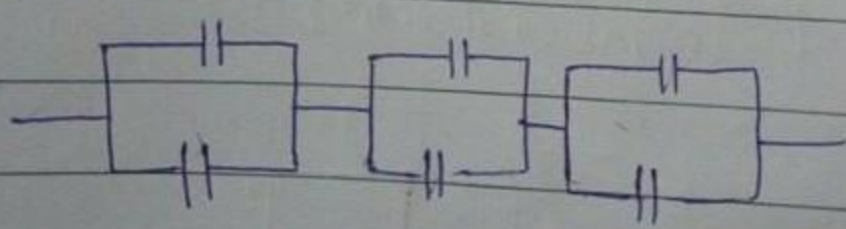
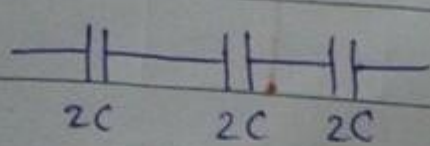
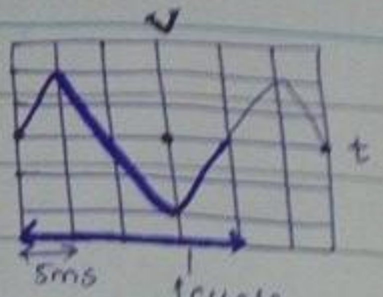




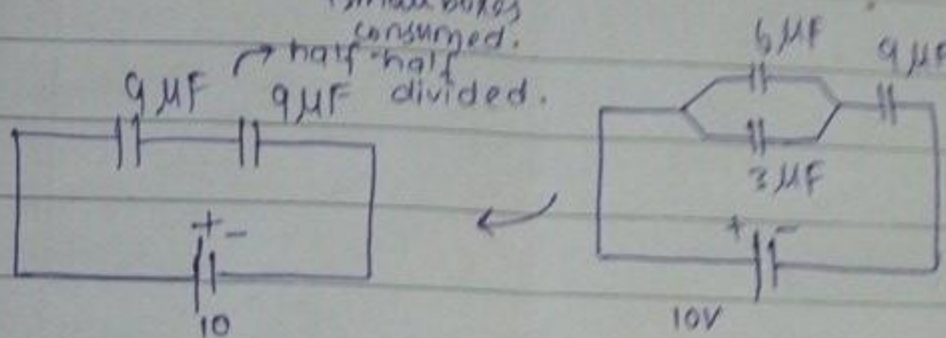
$C_{eq} = \frac{C}{n} = \frac{2C}{3}$



$T = 4 \times 5ms$

$T = 20ms$

$f = \frac{1}{T} = \frac{1}{20\times10^{-3}} = \frac{1000}{20} = 50Hz$



* $X = (\overline{A+B}) + A\cdot B$ $\quad A=0,\ B=1$

$= (\overline{0+1}) + 0\cdot1$

$= (\overline{1}) + 0 = 0+0=0$

Three capacitors of C 3μF, 10μF, 15μF

V = 100V Q on 15μF capacitor is

200μC

$\frac{1}{C_{eq}} = \frac{1}{3} + \frac{1}{10} + \frac{1}{15} = \frac{10+3+2}{30}$

$C_{eq} = \frac{30}{15} = 2\mu F$

$\boxed{Q = C_{eq}V = 200\mu C}$